SMAQMD BACT CLEARINGHOUSE

**ACTIVE**

CATEGORY Type: **PRINTING PROCESS**

BACT Category: MINOR SOURCE BACT

| **BACT Determination Number:** 325 | **BACT Determination Date:** 3/9/2023 |
|---|---|

## Equipment Information

**Permit Number:** N/A -- Generic BACT Determination
**Equipment Description:** LITHOGRAPHIC OFFSET HEATSET
**Unit Size/Rating/Capacity:** ALL
**Equipment Location:**

## BACT Determination Information

**District Contact:** Joe Carle Phone No.: (279) 207-1121 email: jcarle@airquality.org

| | | |
|---|---|---|
| **ROCs** | **Standard:** | APC device with 98% efficiency |
| | **Technology Description:** | Dryer waste gas vented to a VOC control device with 98% control efficiency or an outlet VOC concentration of 10 ppmv and compliance with material limits in SMAQMD Rule 450 Sections 301 & 302 |
| | **Basis:** | Achieved in Practice |
| **NOx** | **Standard:** | 20 ppmv @ 3% O2 or 0.036 lb/MMBtu |
| | **Technology Description:** | Dryer combustion emissions ≤ 20 ppmv @ 3% O2 or ≤ 0.036 lb/MMBtu |
| | **Basis:** | Achieved in Practice |
| **SOx** | **Standard:** | No standard |
| | **Technology Description:** | |
| | **Basis:** | |
| **PM10** | **Standard:** | Vent to VOC control device |
| | **Technology Description:** | Vent dryer waste gas to a VOC contol device |
| | **Basis:** | Achieved in Practice |
| **PM2.5** | **Standard:** | No standard |
| | **Technology Description:** | |
| | **Basis:** | |
| **CO** | **Standard:** | 1000 ppmv @ 3% O2 |
| | **Technology Description:** | Dryer combustion emissions ≤ 1000 ppmv @ 3% O2 |
| | **Basis:** | Achieved in Practice |
| **LEAD** | **Standard:** | No standard |
| | **Technology Description:** | |
| | **Basis:** | |

**Comments:** T-BACT: Capture and vent to VOC control device with at least 98.5% destruction/recovery device efficiency

Printed: 3/15/2023

SMAQMD BACT CLEARINGHOUSE

**ACTIVE**

CATEGORY Type: **PRINTING PROCESS**

BACT Category: MINOR SOURCE

| **BACT Determination Number:** 326 | **BACT Determination Date:** 3/9/2023 |
|---|---|

## Equipment Information

**Permit Number:** N/A -- Generic BACT Determination
**Equipment Description:** LITHOGRAPHIC OFFSET NON-HEATSET
**Unit Size/Rating/Capacity:** ALL
**Equipment Location:**

## BACT Determination Information

**District Contact:** Joe Carle Phone No.: (279) 207-1121 email: jcarle@airquality.org

| | | |
|---|---|---|
| **ROCs** | **Standard:** | Low VOC materials (APC device if emissions ≥ 7806 lb/yr) |
| | **Technology Description:** | Compliance with the material limits in SMAQMD Rule 450 Sections 301 & 302. If the total uncontrolled VOC emissions from the unit are ≥ 7806 lbs/yr, a VOC control system must be installed with at least 98.5% overall system efficiency (capture and destruction). |
| | **Basis:** | Achieved in Practice |
| **NOx** | **Standard:** | No standard |
| | **Technology Description:** | |
| | **Basis:** | |
| **SOx** | **Standard:** | No standard |
| | **Technology Description:** | |
| | **Basis:** | |
| **PM10** | **Standard:** | No standard |
| | **Technology Description:** | |
| | **Basis:** | |
| **PM2.5** | **Standard:** | No standard |
| | **Technology Description:** | |
| | **Basis:** | |
| **CO** | **Standard:** | No standard |
| | **Technology Description:** | |
| | **Basis:** | |
| **LEAD** | **Standard:** | No standard |
| | **Technology Description:** | |
| | **Basis:** | |

**Comments:** T-BACT: Capture and vent to a VOC control device with at least 98.5% destruction/recovery device efficiency.

Printed: 3/15/2023

777 12th Street, Ste. 300

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

Sacramento, CA 95814

# BEST AVAILABLE CONTROL TECHNOLOGY DETERMINATION

| | |
|---|---|
| **DETERMINATION NOS.:** | 325 & 326 |
| **DATE:** | 03/08/23 |
| **ENGINEER:** | Joe Carle |

| | |
|---|---|
| **Category/General Equip Description:** | Printing Process |
| **Equipment Specific Description:** | Lithographic Offset Printing Presses: Heatset and Non-Heatset |
| **Equipment Size/Rating:** | All |
| **Previous BACT Det. No.:** | 250 – Lithographic Offset Heatset<br>251 – Lithographic Offset Non-Heatset |

These determinations focus on lithographic offset printing presses. Offset lithography operates on the repulsion of oil and water. The image is put on thin metal plates which are dampened by a water solution (fountain solution) and ink by rollers on the press. The oil-based inks adhere to the image area and the water solution to the non-image area. The inked area is transferred to a rubber cylinder or “blanket” and then onto paper as it passes around the blanket.

Determination 325 will be for presses that use a heatset process in which the inks on the paper are dried by evaporation in a dryer after the printing unit. Typically, heatset presses are used for very high detail images, for example what one might see in a high quality, glossy finish magazine.

Determination 326 will be for presses that use a non-heatset process. There are two main categories of non-heatset lithographic offset presses. The first category, often called a coldset process, uses standard oil-based inks where the ink will cure through absorption into the underlying material. In this process the VOCs from the ink have a 95% retention on the print material, whereas VOCs from heatset inks have only a 20% retention factor. The second category makes use of specially blended water-based inks that cure through the use of energy like LED light, ultraviolet light (UV), or electron beams (EB). This process uses specialized presses that have the energy curing technology built into the press.

This determination will also include Best Available Control Technology for Toxics (T-BACT) for the hazardous air pollutants (HAP) that could potentially be ingredients in the inks, coatings, solutions, or solvents used in the printing process.

**BACT/T-BACT ANALYSIS**

**A. ACHIEVED IN PRACTICE (Rule 202, §205.1a):**

The following control technologies are currently employed as BACT for lithographic offset printing presses by the following agencies and air pollution control districts:

**US EPA**

**BACT:**
Source: EPA RACT/BACT/LAER Clearinghouse (See Attachment A)

Below shows the most stringent VOC content standards and the VOC control standards for both heatset and non-heatset lithographic offset printing presses that were found.

**RBLC#** IN-0193 (11/13/13)

| | |
|---|---|
| **Press Type:** | Heatset Web Offset Lithography |
| **Control Device Efficiency:** | 98% VOC destruction or 10 ppmv outlet concentration |
| **Material VOC Content Limits:** | As recommended by EPA CTG for Offset Lithographic Printing and Letterpress Printing |

All applicable BACT determinations for heatset lithographic offset presses found in the EPA Clearinghouse were from the Indiana Department of Environmental Management. Most determinations required a control device with 98% VOC destruction efficiency and then required limits equivalent to that which is recommended by the EPA's Control Techniques Guidelines for Offset Lithographic Printing and Letterpress Printing.

**RBLC#** LA-0336 (11/15/18)

| | |
|---|---|
| **Press Type:** | Non-Heatset Offset Lithography |
| **Material VOC Content Limits:** | Use of water-based UV/EB inks<br>Fountain solution ≤ 5% VOC by weight<br>Washes ≤ 10 mm Hg at 20ºC or total VOC ≤ 70% by weight |

The BACT determination above was the only determination found for a lithographic offset non-heatset press. The standards mimic the EPA CTG for Offset Lithographic Printing and Letterpress Printing for a press that uses UV or EB cured inks.

**RULE REQUIREMENTS:**
Although there are no EPA regulations that apply to this source category the EPA has Control Technique Guidelines (CTG) for lithographic printing and the recommended control options will be summarized below.

Control Techniques Guidelines for Offset Lithographic Printing and Letterpress Printing (September 2006)

For heatset web lithographic presses EPA recommends a VOC control device with 95% control efficiency. The CTG does not recommend a control device when inlet emissions are less than 25 tons per year of VOC or for presses that are sheet fed or coldset.
The CTG does not include VOC content limits for the inks themselves but does for other materials such as fountain solutions and cleaning solvents as shown below.

| VOC Content for Fountain Solution Materials | | |
|---|---|---|
| **Material Type** | | **VOC Content Limits % by weight** |
| **Heatset Web Offset Lithography** | | |
| Fountain Solutions Containing Alcohol | Chilled Using Refrigerated Chiller | 3 |
| | Non-Chilled | 1.6 |
| Fountain Solutions Containing No Alcohol | | 5 |
| **Coldset Web Offset Lithography** | | |
| Fountain Solutions Containing Alcohol | | Not allowed |
| Fountain Solutions Containing No Alcohol | | 5 |
| **Sheet-fed Offset Lithography with Maximum Sheet Size > 11 x 17 Inches or Total Solution Reservoir > 1 Gallon** | | |
| Fountain Solutions Containing Alcohol | Chilled using Refrigerated Chiller | 8.5 |
| | Non-Chilled | 5 |
| Fountain Solutions Containing No Alcohol | | 5 |

The CTG recommends use of solvents for blanket washing, roller washing, metering roller cleaners, and other cleaners used for cleaning a press, press parts, or to remove dried ink from areas around the press with a VOC composite vapor pressure less than 10 mm Hg at 20 ºC or containing less than 70% VOC by weight.

## California Air Resource Board (CARB)

**BACT:**
The CARB BACT Guidelines tool did not list any BACT Guidelines that are not already coved by the five Districts listed below.

**RULE REQUIREMENTS:**
None

## Sacramento Metropolitan AQMD

**BACT:**
Source: BACT Determination #250 – Lithographic Offset Heatset Printing Press
Date: 3/24/2020

| Lithographic Offset, Heatset | |
|---|---|
| **Pollutant** | **Standard** |
| VOC | Dryer waste gas vented to a control device with 98% control efficiency or an outlet VOC concentration of 10 ppmv and compliance with the material limits in SMAQMD Rule 450 Sections 301 and 302. |

| Lithographic Offset, Heatset | |
|---|---|
| **Pollutant** | **Standard** |
| NOx | Dryer combustion emissions no more than 30 ppmvd @ 3% $O_2$ |
| SOx | No standard |
| PM10 | Vent dryer waste gas to a VOC control device |
| PM2.5 | No standard |
| CO | Natural gas fuel used in drying oven |
| Organic HAP/VHAP (T-BACT) | Capture and vent VOC control device with at least 98.5% destruction / recovery device efficiency |

Source: BACT Determination #251 – Lithographic Offset Non-heatset Printing Press
Date: 3/24/2020

| Lithographic Offset, Non-Heatset | |
|---|---|
| **Pollutant** | **Standard** |
| VOC | Compliance with the material limits in SMAQMD Rule 450 Sections 301 and 302. If the total uncontrolled VOC emissions from the unit are ≥ 6,480 lbs per year, then a VOC control system must be installed with at least 98.5% overall system efficiency (capture and destruction). (A) |
| NOx | No standard |
| SOx | No standard |
| PM10 | No standard |
| PM2.5 | No standard |
| CO | No standard |
| Organic HAP/VHAP (T-BACT) | Capture and vent VOC control device with at least 98.5% destruction / recovery device efficiency |

(A) The SMAQMD has not permitted a lithographic offset non-heatset press with emissions 6,480 lbs of VOC per year or greater and has not required a VOC control system on a non-heatset press due to BACT. Therefore, the portion of this standard requiring a VOC control system if emissions are 6,480 lbs of VOC per year or greater has not been achieved in practice and should be considered only technologically feasible.

**T-BACT:**
Source: BACT Determination #250 & 251 – Lithographic Offset Printing Presses
Date: 3/24/2020

Capture and vent emissions to a VOC control device with at least 98.5% destruction/recovery device efficiency. This standard applies to both heatset and non-heatset presses.

**RULE REQUIREMENTS:**
Rule 450 – Graphic Arts Operations (Adopted 10/23/08)
This rule applies to any graphic arts operation.

Standards:

| General Printing Materials | |
|---|---|
| **Material Type** | **VOC Content g/l (lb/gal) Less water and exempt compounds** |
| Printing Ink | 300 (2.5) |
| Adhesive | 150 (1.25) |
| Coating | 300 (2.5) |

| VOC Content for Fountain Solution Materials | | |
|---|---|---|
| **Material Type** | | **VOC Content Limits % by weight** |
| **Heatset Web Offset Lithography** | | |
| Fountain Solutions Containing Alcohol | Chilled Using Refrigerated Chiller | 3 |
| | Non-Chilled | 1.6 |
| Fountain Solutions Containing No Alcohol | | 5 |
| **Coldset Web Offset Lithography** | | |
| Fountain Solutions Containing Alcohol | | Not allowed |
| Fountain Solutions Containing No Alcohol | | 5 |
| **Sheet-fed Offset Lithography with Maximum Sheet Size > 11 x 17 Inches or Total Solution Reservoir > 1 Gallon** | | |
| Fountain Solutions Containing Alcohol | Chilled using Refrigerated Chiller | 8.5 |
| | Non-Chilled | 5 |
| Fountain Solutions Containing No Alcohol | | 5 |
| **All Other Presses** | | |
| Fountain Solutions Chilled Using Refrigerated Chiller | | 10 |
| Fountain Solutions Non-Chilled | | 8 |

| Solvent Cleaning Materials | | |
|---|---|---|
| **Material Type** | | **VOC Content g/l (lb/gal) Including water and exempt compounds** |
| General Cleaning | | 25 (0.21) |
| Application Equipment Cleaning | On-Press Components | 100 (0.83) |
| | Removable Press Components | 25 (0.21) |

| Solvent Cleaning Materials | | |
|---|---|---|
| **Material Type** | | **VOC Content g/l (lb/gal) Including water and exempt compounds** |
| | Ultraviolet/Electron Beam Inks | 100 (0.83) |

Heatset web offset lithographic printing presses that have the potential to emit from the drying oven, prior to emissions control equipment, greater than or equal to 25 tons/year of VOC must install air pollution control equipment with an overall system efficiency of 95%.

## South Coast AQMD

**BACT:**
Source: SCAQMD BACT Guidelines for Non-Major Polluting Facilities (Part D) (9/2/22)

| Lithographic or Offset, Heatset | | |
|---|---|---|
| **Pollutant** | **Standard** | **Updated** |
| VOC | Low VOC Fountain Solution (≤ 8% by vol. VOC)<br>Low VOC (≤ 100 g/l) Blanket and Roller Washes<br>Oil-Based or UV-Curable Inks<br>Compliance with SCAQMD Rules 1130 and 1171 | 2/2/18 |
| | Oven vented to a thermal oxidizer (≥ 0.3 sec. Retention Time at ≥ 1,400 °F; 95% Overall Efficiency) | 10/20/00 |
| NOx | Compliance with BACT requirements for Thermal Oxidizer<br>Compliance with BACT requirements for Other Dryers and Ovens | 9/2/22 |
| SOx | No standard | N/A |
| PM10 | Venting to a thermal oxidizer (≥ 0.3 sec. Retention Time at ≥ 1,400 °F) | 2/1/19 |
| PM2.5 | No standard | N/A |
| CO | Compliance with BACT requirements for Thermal Oxidizer | N/A |

| Lithographic or Offset, Non-Heatset | | |
|---|---|---|
| **Pollutant** | **Standard** | **Updated** |
| VOC | Low VOC Fountain Solution (≤ 8% by vol. VOC)<br>Low VOC (≤ 100 g/L) Blanket and Roller Washes<br>Oil-Based or UV-Curable Inks<br>Compliance with SCAQMD Rules 1130 and 1171 | 2/1/19 |
| NOx | No standard | N/A |
| SOx | No standard | N/A |

| Lithographic or Offset, Non-Heatset | | |
|---|---|---|
| **Pollutant** | **Standard** | **Updated** |
| PM10 | No standard | N/A |
| PM2.5 | No standard | N/A |
| CO | No standard | N/A |

| Other Dryers and Ovens – Direct and Indirect Fired (Excluding digester or landfill gas fired units) | | |
|---|---|---|
| **Pollutant** | **Standard** | **Updated** |
| VOC | Afterburner (≥ 0.3 sec. Retention Time at ≥ 1,400 °F) | 1988 |
| NOx | 30 ppmvd @ 3% $O_2$ | 4/10/98 |
| SOx | Natural Gas | 10/20/00 |
| PM10 | Natural Gas | 10/20/00 |
| PM2.5 | No standard | N/A |
| CO | No standard | N/A |

**T-BACT:**
There are no T-BACT standards published in the clearinghouse for this category.

**RULE REQUIREMENTS:**
Reg XI, Rule 1130 – Graphic Arts (5/2/14)
This rule is applicable any graphic arts operation.

Standards:

| Inks, Adhesive, and Coatings | |
|---|---|
| Graphic Arts Material | VOC Content (g/L) |
| Adhesive | 150 |
| Coating | 300 |
| Offset Lithographic Ink | 300 |

| VOC Content for Fountain Solution Materials | | |
|---|---|---|
| **Material Type** | | **VOC Content Limits (g/L)** |
| **Heatset Web-Fed** | | |
| Using Alcohol | Without Refrigerated Chiller | 16 |
| | With Refrigerated Chiller | 30 |

| VOC Content for Fountain Solution Materials | | |
|---|---|---|
| **Material Type** | | **VOC Content Limits (g/L)** |
| Using Alcohol Substitute | | 50 |
| **Sheet-Fed** | | |
| Using Alcohol | Without Refrigerated Chiller | 50 |
| | With Refrigerated Chiller | 85 |
| Using Alcohol Substitute | | 50 |
| **Non-Heatset Web-Fed** | | |
| Using Alcohol | | Prohibited |
| Using Alcohol Substitute | | 50 |

An owner or operator may install a control device which reduces VOC by 95% by weight from an emission collection system that collects at least 90% of the VOC emissions generated by the source instead of complying with the VOC content limits in the tables above.

Reg XI, Rule 1171 – Solvent Cleaning Operations (5/1/09)
This rule applies to any operation where solvent cleaning is conducted as part of a business.

| Solvent Cleaning of Ink Application Equipment | | |
|---|---|---|
| **Type** | | **VOC Content Limit g/l (lb/gal)** |
| General | | 25 (0.21) |
| Lithographic (Offset) | Roller Wash, Blanket Wash, & On-Press Components | 100 (0.83) |
| | Removable Press Components | 25 (0.21) |
| Ultraviolet Ink/ Electron Beam Ink Application Equipment | | 100 (0.83) |

Reg XI, Rule 1147 – NOx Reductions from Miscellaneous Sources (5/6/22)
This rule applies to manufacturers, distributers, retailers, installers, owners, and operators of gaseous and/or liquid fuel fired combustion equipment with NOx emissions that require that require a South Coast AQMD permit and when other South Coast AQMD Regulation XI rules are not applicable to the Unit.

| **Equipment Category** | **Process Temperature** | **Emission Limit (ppmv corrected to 3% $O_2$, dry unless otherwise specified)** | |
|---|---|---|---|
| | | **NOx** | **CO** |
| Gaseous Fuel-Fired Afterburner, Degassing Unit, Thermal Oxidizer, Catalytic Oxidizer or Vapor Incinerator | All | 20 ppmv or 0.024 lb/MMBtu | 1,000 ppmv |

| Equipment Category | Process Temperature | Emission Limit (ppmv corrected to 3% $O_2$, dry unless otherwise specified) | |
|---|---|---|---|
| | | NOx | CO |
| Gaseous Fuel-Fired Oven, Dehydrator, Dryer, Heater, Kiln, Calciner, Cooker, Roaster, Furnace, or Heated Storage Tank | < 1,200 ºF | 20 ppmv or 0.024 lb/MMBtu | 1,000 ppmv |
| | ≥ 1,200 ºF | 30 ppmv or 0.036 lb/MMBtu | 1,000 ppmv |
| All liquid fuel-fired Units | < 1,200 ºF | 40 ppmv or 0.053 lb/MMBtu | 1,000 ppmv |
| | ≥ 1,200 ºF | 60 ppmv or 0.073 lb/MMBtu | 1,000 ppmv |

## San Joaquin Valley APCD

**BACT:**
Source: SJVAPCD BACT Guideline 4.7.1 (5/11/22)

This determination has been rescinded as of May 11, 2022.

Source: SJVAPCD BACT Guideline 4.7.2 (10/15/10)

| Offset Lithographic Printing – Non-heat Set Press | | |
|---|---|---|
| Pollutant | Standard | |
| | Achieved in Practice | Technologically Feasible |
| VOC | Using materials with the following VOC contents:<br>Inks: less than 5% VOC by weight (less water and exempt compounds) or less than 30% VOC by weight (less water and exempt compounds) for high end graphics.<br>Fountain Solutions: less than 5% by volume for coldset web offset lithographic, less than 5% by volume for sheet-fed offset lithographic with maximum sheet size greater than 11x17 inches, and less than 8% by volume for high end graphics | VOC capture and incineration; or VOC capture and carbon adsorption and using materials with the following VOC contents:<br>Inks: less than 5% VOC by weight (less water and exempt compounds) or less than 30% VOC by weight (less water and exempt compounds) for high end graphics.<br>Fountain Solutions: less than 5% by volume for coldset web offset lithographic, less than 5% by volume for sheet-fed offset lithographic with maximum sheet size greater than 11x17 inches, and less than 8% by volume for high end graphics |
| NOx | N/A | N/A |
| SOx | N/A | N/A |
| PM10 | N/A | N/A |
| PM2.5 | N/A | N/A |

| Offset Lithographic Printing – Non-heat Set Press | | |
|---|---|---|
| **Pollutant** | **Standard** | |
| | **Achieved in Practice** | **Technologically Feasible** |
| CO | N/A | N/A |

**T-BACT:**
There are no T-BACT standards published in the clearinghouse for this category.

**RULE REQUIREMENTS:**
Rule 4607 – Graphic Arts and Paper, Film, Foil and Fabric Coatings (12/18/08)
The VOC material standards are applicable to any graphic arts printing operation that emits 200 pounds or more VOC per 12 rolling consecutive calendar months.

| VOC Content Limits for Inks, Coatings, and Adhesives | |
|---|---|
| **Material** | **Grams of VOC per liter (lb/gal), less water and exempt compounds, as applied** |
| Inks | 300 (2.5) |
| Coatings | 300 (2.5) |
| Adhesives | 150 (1.25) |

| VOC Content Limits for Fountain Solution | |
|---|---|
| **Material** | **Percent VOC by Volume** |
| Heatset Web Offset Lithographic | 1.6 |
| Coldset Web Offset Lithographic | 5.0 |
| Sheet-fed Offset Lithographic with maximum sheet size greater than 11 x 17 inches | 5.0 |
| All Other Presses | 8.0 |

| VOC Content Limits for Solvent Cleaning | |
|---|---|
| **Type of Solvent Cleaning Operation** | **Grams of VOC per liter (lb/gal)** |
| Surface Preparation for Coating, Ink, or Adhesive Application | 25 (0.21) |
| Repair and Maintenance Cleaning | 25 (0.21) |
| Cleaning of Coating or Adhesive Application Equipment | 25 (0.21) |

| VOC Content Limits for Solvent Cleaning | |
|---|---|
| **Type of Solvent Cleaning Operation** | **Grams of VOC per liter (lb/gal)** |
| Lithographic (Offset) Roller Wash, Blanket Wash, and On-Press Components | 100 (0.83) |
| Lithographic (Offset) Removable Press Components | 25 (0.21) |
| Ultraviolet Ink / Electron Beam Ink Application Equipment | 100 (0.83) |

In lieu of complying with the material limits in this rule a VOC emission control system may be used that has an overall VOC capture and control efficiency of 75% for lithographic offset printing presses.

## San Diego County APCD

**BACT:**
Source: NSR Requirements for BACT (June 2011), (pg 3-14)

| Graphics Arts Operations (< 5 tons/year) | | |
|---|---|---|
| **Pollutant** | **Standard** | |
| | **Achieved in Practice** | **Technologically Feasible** |
| VOC | 1. Use of low VOC fountain solution (< 6% VOC by volume),<br>2. Capture & recycle blanket and roller tray wash,<br>3. Use of cleanup solvent which has either less than 200 grams VOC per liter or vapor pressure of less than 5 mm Hg at 20 °C,<br>4. Use of metering roll cleanup solvent which has less than 100 grams VOC per liter or vapor pressure of less than 10 mm Hg at 20 °C, and<br>5. Use of inks which have a VOC content of less than 300 grams per liter (2.5 lb/gal). | 1. Use of low VOC fountain solution (< 5% VOC by volume),<br>2. Capture & recycle blanket and roller tray wash,<br>3. Use of cleanup solvent which has either less than 100 grams VOC per liter or vapor pressure of less than 5 mm Hg at 20 °C,<br>4. Use of metering roll cleanup solvent which has less than 100 grams VOC per liter or vapor pressure of less than 5 mm Hg at 20 °C, and<br>5. Use of inks which have a VOC content of less than 225 grams per liter (1.9 lb/gal). |
| NOx | N/A | N/A |
| SOx | N/A | N/A |
| PM10 | N/A | N/A |
| PM2.5 | N/A | N/A |

| Graphics Arts Operations (< 5 tons/year) | | |
|---|---|---|
| **Pollutant** | **Standard** | |
| | **Achieved in Practice** | **Technologically Feasible** |
| CO | N/A | N/A |

**T-BACT:**
There are no T-BACT standards published in the clearinghouse for this category.

**RULE REQUIREMENTS:**
Rule 67.16 – Graphic Arts Operations (11/9/11)

This rule applies to all continuous web or single sheet fed graphic arts printing, processing, laminating or drying operations and digital printing operations.

The material standards of this rule do not apply to stationary sources which emit less than an average of 15 lbs of VOC from all graphic arts operations per day of operation, excluding digital printing operations, for each calendar month.

Graphic arts materials (except adhesives): < 300 grams of VOC per liter (2.5 lb/gal) as applied, less water and exempt compounds.

Adhesives: ≤ 150 grams of VOC per liter (1.25 lb/gal), as applied, less water and exempt compounds.

Fountain solutions: ≤ 5% VOC by volume or ≤ 8.5% VOC by volume refrigerated to a temperature below 60°F.

Cleaning material: < 100 grams VOC per liter or the total VOC vapor pressure is 5 mm of Hg at 20 °C or less.

In lieu of complying with the material standards, install and operate a VOC emission capture and control device with efficiency of at least 85% by weight.

## Bay Area AQMD

**BACT:**
Source: BAAQMD BACT Guideline 110.1.1 (8/24/98)

| Lithographic or Offset Printing - Heatset | | |
|---|---|---|
| **Pollutant** | **Standard** | |
| | **Achieved in Practice** | **Technologically Feasible** |
| VOC | Low VOC fountain solution (≤ 8% by vol.); and minimum possible VOC blanket wash & roller & tray washes; and cleanup solvents w/ ≤ 7.5 lb VOC/gal and VOC vapor pressure ≤ 25 mm Hg or ≤ 30% by vol. VOC; and kerosene-like oil based inks | Low VOC fountain solution (≤ 6% by vol.); an automatic blanket & roller wash w/ solvent capture & recycle; and cleanup solvents w/ ≤ 2.5 lb VOC/gal or VOC vapor pressure ≤ 5 mm Hg; and kerosene-like oil-based inks. If cost-effective, capture and vent VOC to afterburner or carbon adsorption system w/ ≥ 98.5% destruction / recovery device efficiency or VOC outlet ≤ 10 ppmv |
| NOx | N/A | N/A |
| SOx | N/A | N/A |
| PM10 | Compliance with Reg. 6, Visible Emissions. | Oven venting to an afterburner (≥ 0.3 sec. retention time at ≥ 1,400 °F) w/ overall capture/destruction efficiency ≥ 90% |
| PM2.5 | N/A | N/A |
| CO | N/A | N/A |

Source: BAAQMD BACT Guideline 110.2.1 (8/24/98)

| Offset Lithographic Printing – Non-heat Set Press | | |
|---|---|---|
| **Pollutant** | **Standard** | |
| | **Achieved in Practice** | **Technologically Feasible** |
| VOC | Low VOC fountain solution (≤ 8% by vol.); and minimum possible VOC blanket wash & roller & tray washes; and cleanup solvents w/ ≤ 7.5 lb VOC/gal and VOC vapor pressure ≤ 25 mm Hg or ≤ 30% by vol. VOC; and kerosene-like oil based inks | Low VOC fountain solution (≤ 6% by vol.); an automatic blanket & roller wash w/ solvent capture & recycle; and cleanup solvents w/ ≤ 2.5 lb VOC/gal or VOC vapor pressure ≤ 5 mm Hg; and kerosene-like oil-based inks. If cost-effective, capture and vent VOC to afterburner or carbon adsorption system w/ ≥ 98.5% destruction / recovery device efficiency or VOC outlet ≤ 10 ppmv |
| NOx | N/A | N/A |
| SOx | N/A | N/A |
| PM10 | N/A | N/A |
| PM2.5 | N/A | N/A |
| CO | N/A | N/A |

**T-BACT:**
T-BACT standard is referenced as the VOC standard for both heatset and non-heatset lithographic offset printing presses.

**RULE REQUIREMENTS:**
Regulation 8, Rule 20 – Graphic Arts Printing and Coating Operations (11/19/08)
This rule applies to all graphic arts operations.

| Product Limits | |
|---|---|
| **Material** | **grams VOC per liter of product as applied, less water and exempt solvent (lbs/gal)** |
| Ink | 300 (2.5) |
| Coating | 300 (2.5) |
| Adhesive | 150 (1.25) |
| Web Splicing Adhesive | 300 (2.5) |

Fountain Solution is limited to 8% VOC by volume.

| Cleaning Product Limits | |
|---|---|
| **Equipment** | **VOC g/l (lb/gal) including water** |
| Specialty Lithographic Press | 100 (0.83) |
| Lithographic Press, by Manual Washing | 100 (0.83) |
| Lithographic Press, by Automatic Washing | 100 (0.83) |
| Adhesive Application Equipment | 25 (0.21) |
| Ultraviolet Ink Removal | 100 (0.83) |
| Other Press Parts[1] | 25 (0.21) |

[1] Press parts that do not come into contact with inks, adhesives, or coatings. Other press parts include, but are not limited to, pressure rollers, motors, and belts.

In lieu of compliance with the above material limits a VOC emission control system is installed that has an overall efficiency of at least 75% on a mass basis.

## Summary of Achieved in Practice Control Technologies

The following control technologies have been identified and are ranked based on stringency:

**Heatset Printing Presses – VOC**

Controls for limiting VOC emissions rely on either reducing the VOC content of the materials used in the printing operation and/or use of a VOC emission control device. In a heatset

printing process the waste gas from the dryer would be vented to a VOC control device if required, which would control most VOC emissions from the process. In terms of stringency a control device would reduce VOC emissions more than using low VOC printing material and, therefore, will be ranked as such.

| **Achieved in Practice VOC Standards for Lithographic Offset Heatset Printing** | | | | | |
|---|---|---|---|---|---|
| Rank | Standard | Technology Description | Source | Year | Comments |
| 1 | • Dryer waste gas vented to a control device with 98% control efficiency or an outlet VOC concentration of 10 ppmv, and<br>• Compliance with the material limits in SMAQMD Rule 450 Sections 301 and 302. | VOC control device and low VOC materials | SMAQMD BACT | 2020 | |
| 2 | • VOC control device with 98% destruction or 10 ppmv outlet, and<br>• Use of fountain solutions and cleaning solvents as recommended in the CTG | VOC control device and Low VOC Materials | EPA BACT | 2015 | |
| 3 | • Low VOC Fountain Solution (≤ 8% by vol. VOC),<br>• Low VOC (≤ 100 g/l) Blanket and Roller Washes,<br>• Oil-Based or UV-Curable Inks,<br>• Compliance with SCAQMD Rules 1130 and 1171, and<br>• Oven Vented to a thermal oxidizer (≥ 0.3 sec. Retention Time at ≥ 1,400 $^{o}$F; 95% Overall Efficiency) | Thermal Oxidizer and Low VOC Materials | SCAQMD BACT | 2022 | |

| Achieved in Practice VOC Standards for Lithographic Offset Heatset Printing | | | | | |
|---|---|---|---|---|---|
| Rank | Standard | Technology Description | Source | Year | Comments |
| 4 | • Inks & coatings ≤ 300 g/l<br>• Adhesive ≤ 150 g/l<br>• Web-feed fountain solution ≤ 1.6% by volume<br>• Sheet-fed with a maximum size of 11x17" fountain solution ≤ 5% by volume<br>• Other fountain solution ≤ 8% by volume<br>• Solvent cleaning for blanket, rollers and on press components ≤ 100 g/l<br>• All other solvent cleaning ≤ 25 g/l | Low VOC Materials | SJVAPCD Rule | 2008 | |
| 5 | • Fountain Solution < 6% VOC by volume;<br>• Capture & recycle blanket and roller tray wash;<br>• Cleanup solvent with < 200 g/l VOC or with a vapor pressure of < 5 mm Hg at 20 °C;<br>• Metering roll wash < 100 g/l VOC or vapor pressure of < 10 mm Hg at 20 °C;<br>• Inks < 300 g/l VOC<br>or<br>• Compliance with Graphic Arts Rule 67.16 | Low VOC Materials | SDCAPCD BACT/Rule | 2011/ 2012 | Parts of the Graphic Arts rule are more stringent than the BACT and vice versa. Therefore, facilities would need to comply with the most stringent standard between the two<br><br>This BACT determination is not specific to heatset printers and is only required for operations |
| 6 | • Inks, coatings, web splicing adhesive ≤ 300 g/l<br>• General adhesive ≤ 150 g/l<br>• Fountain solution ≤ 8% by volume<br>• Solvent cleaning for specialty presses, manual washing, and automatic washing ≤ 100 g/l<br>• General solvent cleaning and for adhesive application equipment ≤ 25 g/l | Low VOC Materials | BAAQMD Rule | 2008 | |

**Heatset Printing Presses – NOx**

NOx emissions in heatset printing come from fuel combustion for the dryer. EPA AP-42 Section 4.9.1 for Graphic Arts states that typical temperatures for lithographic dryers range from 400 to 500 °F. Although, SCAMQD has a less stringent NOx standard for dryers with a process temperature of at least 1,200 °F, it will not be listed because process temperatures at this level are unrealistic for this type of application.

| Achieved in Practice NOx Standards for Lithographic Offset Heatset Printing | | | |
|---|---|---|---|
| Rank | Standard | Source | Year |
| 1 | 20 ppmv @ 3% $O_2$ or 0.036 lb/MMBtu | SCAQMD Rule | 2022 |
| 2 | 30 ppmvd @ 3% $O_2$ | SMAQMD BACT | 2020 |
| 3 | No standard | EPA, SJVUAPCD, SDCAPCD, BAAQMD | N/A |

**Heatset Printing Presses – CO**

Emissions for CO in heatset printing come from fuel combustion for the dryer.

| Achieved in Practice CO Standards for Lithographic Offset Heatset Printing | | | |
|---|---|---|---|
| Rank | Standard | Source | Year |
| 1 | 1,000 ppmv @ 3% $O_2$ | SCAQMD Rule | 2022 |
| 2 | Use of natural gas fired dryer | SMAQMD BACT | 2020 |
| 3 | No standard | EPA, SJVUAPCD, SDCAPCD, BAAQMD | N/A |

**Heatset Printing Presses – PM10**

Heatset inks typically will contain a petroleum-based oil and during the heating process the oils will condense and form PM10 droplets. The BAAQMD specifically lists in their BACT determination that PM10 emissions must comply with the visible emissions regulations. Although, this requirement is not listed for other air districts (because it is not specifically outlined in a BACT determination) typically any equipment regardless of BACT standard being set is required to comply with visible emission requirements.

| Achieved in Practice PM10 Standards for Lithographic Offset Heatset Printing | | | |
|---|---|---|---|
| Rank | Standard | Source | Year |
| 1 | Vent dryer waste gas to a VOC control device | SMAQMD BACT | 2020 |
| 1 | Venting to an Afterburner (≥ 0.3 sec. Retention Time at ≥ 1,400 °F) | SCAQMD BACT | 2019 |
| 2 | Compliance with Reg. 6, Visible Emissions | BAAQMD BACT | 1998 |

| Achieved in Practice PM10 Standards for Lithographic Offset Heatset Printing | | | |
|---|---|---|---|
| Rank | Standard | Source | Year |
| 1 | Vent dryer waste gas to a VOC control device | SMAQMD BACT | 2020 |
| 3 | No standard | EPA, SMAQMD, SJVAPCD, SDCAPCD | N/A |

**Non-heatset Printing Presses – VOC**

Emission limits for fountain solutions vary from rule to rule mostly based on how the emission limit is expressed. SCAQMD lists emission limits for fountain solutions in grams per liter while SMAQMD expresses the limit in percent VOC by mass, and SJVUAPCD expresses the limits in percent VOC by volume. It is difficult to compare these limits because percent by mass and volume can vary from solution to solution depending upon its physical properties.

The EPA Control Techniques Guidelines for Offset Lithographic Printing and Letter Press Printing (CTG) list recommends emission standards as percent mass. The SMAQMD Rule also lists these identical standards as a percent mass. SCAQMD updated their emission limits for fountain solutions in 2014. In their staff report for these amendments they state that their emission limits are equivalent to those of the CTG except they have converted the limits to grams per liter to remain consistent with the previous emission limits for fountain solutions. Additionally, in 2008, amendments were made to SJVUAPCD Rule 4607, according to the associated staff report, to align the emission standards to that of other districts and the CTG.

Even though the emission limits for fountain solutions differ in the way they are expressed between the SCAQMD, SMAQMD, and SJVUAPCD all districts claim to be equivalent to the recommendations in the CTG.

The previous SMAQMD BACT Determination required a VOC control device for units emitting at least 6,480 lbs of uncontrolled VOC per year. This emissions threshold was based on what was considered technologically feasible and cost effective at the time the determination was developed. This portion of the VOC standard has never been required for a lithographic offset non-heatset printing press. Therefore, the achieved in practice standard will only be considered compliance with their graphic arts rule standards.

| Achieved in Practice VOC Standards for Lithographic Offset Non-heatset Printing | | | | |
|---|---|---|---|---|
| Rank | VOC Standard | Source | Year | Comments |
| 1 | Compliance with the material limits in SMAQMD Rule 450 Sections 301 and 302<br>• Inks & Coatings: 300 g/l (2.5 lb/gal)<br>• Adhesives: 150 g/l (1.25 lb/gal)<br>• Fountain solutions equivalent to CTG<br>• Cleaning solvents for on-press components or ultraviolet/electron beam inks: 100 g/l (0.83 lb/gal)<br>• Solvents for general or removable press component cleaning: 25 g/l (0.21 lb/gal) | SMAQMD BACT | 2020 | |

| Achieved in Practice VOC Standards for Lithographic Offset Non-heatset Printing | | | | |
|---|---|---|---|---|
| Rank | VOC Standard | Source | Year | Comments |
| 1 | Compliance with SCAQMD Rules 1130 and 1171<br>• Inks & Coatings: 300 g/l (2.5 lb/gal)<br>• Adhesives: 150 g/l (1.25 lb/gal)<br>• Fountain solutions equivalent to CTG (at least 8% by volume)<br>• Cleaning solvents for on-press components or ultraviolet/electron beam inks: 100 g/l (0.83 lb/gal)<br>Solvents for general or removable press component cleaning: 25 g/l (0.21 lb/gal) | SCAQMD BACT | 2019 | SCAQMD BACT requires compliance with Graphic Arts Rule 1130 and Solvent Cleaning Operations Rule 1171 |
| 1 | • Inks: 5% by weight for low end graphics (A); 30% by weight for high end graphics (A) or 300 g/l (2.5 lb/gal) whichever is more stringent.<br>• Coatings: 300 g/l (2.5 lb/gal)<br>• Adhesives: 150 g/l (1.25 lb/gal)<br>• Fountain solutions equivalent to CTG<br>• Cleaning solvents for on-press components or ultraviolet/electron beam inks: 100 g/l (0.83 lb/gal)<br>• Solvents for general or removable press component cleaning: 25 g/l (0.21 lb/gal) | SJVUAPCD BACT/Rule | 2010/ 2008 | Rule limits were used for material standards not specified in the BACT determination |
| 2 | • Inks & Coatings: 300 g/l (2.5 lb/gal)<br>• Adhesives: 150 g/l (1.25 lb/gal)<br>• Fountain solutions: 5% by volume or 8.5% by volume if refrigerated to a temperature below 60 $^{o}$F<br>• Capture and recycle blanket and roller tray wash<br>• Cleaning solvents: 100 g/l (0.83 lb/gal) or a vapor pressure of 5 mm Hg at 20 $^{o}$C. | SDCAPCD Rule/BACT | 2012/ 2011 | Requirement to capture and recycle washes is from the BACT determination otherwise standards are from Rule |
| 3 | • Inks & Coatings: 300 g/l (2.5 lb/gal)<br>• Web Splicing Adhesive: 300 g/l (2.5 lb/gal)<br>• All Other Adhesives: 150 g/l (1.25 lb/gal)<br>• Fountain solutions: 8% by volume<br>• Cleaning solvents for on-press components or ultraviolet/electron beam inks: 100 g/l (0.83 lb/gal)<br>• Solvents for general or adhesive application equipment cleaning: 25 g/l (0.21 lb/gal) | BAAQMD Rule | 2008 | |
| NA | • Use of water-based UV/EB inks<br>• Fountain solution ≤ 5% VOC by weight<br>• Washes ≤ 10 mm Hg at 20 ºC or total VOC ≤ 70% by weight | EPA BACT | 2018 | Determination not ranked because it is specific to a UV/EB printing press |

(A) According to SJVAPCD permit language, high-end graphic print jobs are defined as any print job that has a glossy finish, multiple colors, highly refined graphic image, or very high letter-quality printing. Low-end graphic print jobs are defined as anything not high-end graphic.

## Toxics:

| Achieved in Practice Toxic Standards for Lithographic Offset Heatset & Non-Heatset Printing | | | |
|---|---|---|---|
| Rank | Organic HAP/VHAP Standard | Source | Year |
| 1 | Capture and vent VOC control device with at least 98.5% destruction / recovery device efficiency | SMAQMD BACT | 2020 |
| 2 | Low VOC fountain solution (≤ 8% by vol.); and minimum possible VOC blanket wash & roller & tray washes; and cleanup solvents w/ ≤ 7.5 lb VOC/gal and VOC vapor pressure ≤ 25 mm Hg or ≤ 30% by vol. VOC; and kerosene-like oil based inks | BAAQMD BACT | 1989 |

## Summary Table:

The following control technologies have been identified as the most stringent, achieved in practice control technologies. The SMAQMD Rule 450 material standards have been referenced for convenience, for enforcement purposes, when possible:

| Best Control Technologies Achieved in Practice for Heatset Lithographic Offset Printing | | |
|---|---|---|
| Pollutant | Standard | Source |
| VOC | Dryer waste gas vented to a control device with 98% control efficiency or an outlet VOC concentration of 10 ppmv, and Compliance with the material limits in SMAQMD Rule 450 Sections 301 and 302. | SMAQMD BACT |
| NOx | 20 ppmv @ 3% $O_2$ or 0.036 lb/MMBtu | SCAQMD Rule |
| SOx | No standard | N/A |
| PM10 | Vent dryer waste gas to a VOC control device | SMAQMD BACT |
| PM2.5 | No standard | N/A |
| CO | 1,000 ppmv @ 3% $O_2$ | SCAQMD Rule |
| Organic HAP/VHAP (T-BACT) | Capture and vent VOC control device with at least 98.5% destruction / recovery device efficiency | SMAQMD BACT |

| Best Control Technologies Achieved in Practice for Non-Heatset Lithographic Offset Printing | | |
|---|---|---|
| Pollutant | Standard | Source |
| VOC | Compliance with the material limits in SMAQMD Rule 450 Sections 301 and 302. | SMAQMD BACT |
| NOx | No standard | N/A |
| SOx | No standard | N/A |
| PM10 | No standard | N/A |
| PM2.5 | No standard | N/A |
| CO | No standard | N/A |
| Organic HAP/VHAP (T-BACT) | Capture and vent VOC control device with at least 98.5% destruction / recovery device efficiency | SMAQMD BACT |

## B. TECHNOLOGICALLY FEASIBLE AND COST EFFECTIVE (Rule 202, §205.1.b.):

**Technologically Feasible Alternatives:**
Any alternative basic equipment, fuel, process, emission control device or technique, singly or in combination, determined to be technologically feasible by the Air Pollution Control Officer.

The table below shows the technologically feasible alternatives identified as capable of reducing emissions beyond the levels determined to be "Achieved in Practice" as per Rule 202, §205.1.a.

| Technologically Feasible Alternatives | | | |
|---|---|---|---|
| **Pollutant** | **Emission Source Category** | **Standard** | **Source of Standard** |
| **VOC** | Heatset | No other technologically feasible option identified | N/A |
| | Non-Heatset | • Carbon Adsorption System<br>• Thermal Oxidizer | SMAQMD & BAAQMD |
| **NOx** | All Presses | No other technologically feasible option identified | N/A |
| **SOx** | All Presses | No other technologically feasible option identified | N/A |
| **PM10** | All Presses | No other technologically feasible option identified | N/A |
| **PM2.5** | All Presses | No other technologically feasible option identified | N/A |
| **CO** | Heatset | No other technologically feasible option identified | N/A |
| | Non-Heatset | No other technologically feasible option identified | N/A |

| Technologically Feasible Alternatives | | | |
|---|---|---|---|
| **Pollutant** | **Emission Source Category** | **Standard** | **Source of Standard** |
| Organic HAP/VHAP (T-BACT) | Heatset | No other technologically feasible option identified | N/A |
| | Non-Heatset | No other technologically feasible option identified | N/A |

Two common types of VOC control devices are carbon adsorption systems and thermal oxidizers. BACT Determinations from the SMAQMD and BAAQMD show a maximum overall VOC control effectiveness of 98.5%. As these kinds of devices have been used in other applications to control VOC it will be determined to be technologically feasible if cost effective.

**Cost Effective Determination:**

The use of low VOC materials could make emissions low enough where these devices are not cost effective. Therefore, the analysis below will calculate the threshold for annual VOC emissions where the control device would become cost effective. The cost effectiveness threshold for VOC is a maximum cost of $17,500 per ton of VOC reduced. A summary of the cost effectiveness calculations using the 2018 EPA Air Pollution Cost Control Manual calculations and assumptions are show below.

Basic assumptions:

1) Single 4-color lithographic printing press operation.
2) Operation based on 8 hours per day, 5 days per week, 52 weeks per year.
3) Press room dimensions: 40'W x 60'L x 20'H (because the press room is relatively small, a hood is not necessary)
4) The press room is assumed to be the enclosure with an overall system efficiency of 98.5% and venting to the control device through a general ventilation system.
5) Overall design of the system specified was chosen because it yielded the lowest annual costs.
6) Electricity cost was set at $0.1124 per kWh and natural gas cost was set at $14.60 per 1,000 scf. Both were based on the most current local industrial rates.
7) Cost adjusted to 2022 dollars based on the CPI.
8) All other cost calculations and assumptions are based on the EPA Air Pollution Control Cost Manual (2018).

**Carbon Adsorption System**

System Type: Horizontal Stainless Steel (304) Fixed-Beds with Steam Regeneration

Waste Gas Flow Rate = 8,000 acfm (10 air changes per hour)

Equipment Life = 15 years (EPA recommended value)

Total Capital Investment = $337,276

Direct Annual Cost = $13,432 per year

Indirect Annual Cost = $57,494 per year

VOC Recovery Credit = $2,576 per year

Total Annual Cost = $68,351 per year

VOC Removed = 3.90 tons per year

**Cost of VOC Removal = $17,512 per ton reduced**

A detailed calculation of the cost effectiveness for VOC removal with a carbon absorber is shown in Attachment B. Uncontrolled VOC emissions of 7,806 lb/year or greater is the cost-effective threshold for control equipment using carbon absorption control technology.

**Thermal Oxidizer:**

System Type: Regenerative Thermal Oxidizer

Waste Gas Flow Rate = 20,000 scfm (EPA recommended value)

Equipment Life = 20 years (EPA recommended value)

Total Capital Investment = $1,435,800

Direct Annual Cost = $101,474 per year

Indirect Annual Cost = $200,142 per year

Total Annual Cost = $301,617 per year

VOC Removed = 17.20 tons per year

**Cost of VOC Removal = $17,535 per ton reduced**

A detailed calculation of the cost effectiveness for VOC removal with a thermal oxidizer is shown in Attachment C. Uncontrolled VOC emissions of 34,924 lb/year or greater is the cost-effective threshold for control equipment using thermal oxidation control technology.

Conclusion: In this analysis, different emission operating levels are presented with the corresponding total cost per ton of VOC controlled using either a carbon adsorption control or a thermal oxidizer. Uncontrolled VOC emission level of 7,806 lb per year or greater must be reached in order for the carbon absorption control option to be cost effective. Uncontrolled VOC emission level of 34,924 lb per year or greater must be reached in order for a thermal oxidizer to be cost effective. The emissions levels for the cost effectiveness of controls are based on the District cost effective limit for VOC of $17,500 per ton controlled. Therefore, using the 2018 EPA Air Pollution Cost Control Manual calculations and assumptions it is technologically feasible and cost effective to require a VOC control device if total uncontrolled VOC emissions are at least 7,806 lbs per year for a lithographic offset non-heatset printing press.

## C. SELECTION OF BACT:

Based on the above analysis, BACT for VOC, NOx, SOx, PM10, and CO will remain at what is currently achieved in practice.

| BACT DETERMINATION #325 FOR HEATSET LITHOGRAPHIC OFFSET PRINTING | | |
|---|---|---|
| **Pollutant** | **Standard** | **Source** |
| VOC | Dryer waste gas vented to a control device with 98% control efficiency or an outlet VOC concentration of 10 ppmv and compliance with the material limits in SMAQMD Rule 450 Sections 301 and 302. | SMAQMD |
| NOx | Dryer combustion ≤ 20 ppmv @ 3% $O_2$ or 0.036 lb/MMBtu | SCAQMD |
| SOx | No standard | N/A |
| PM10 | Vent dryer waste gas to a VOC control device | SMAQMD |
| PM2.5 | No standard | N/A |
| CO | 1,000 ppmv @ 3% $O_2$ | SCAQMD |
| Organic HAP/VHAP (T-BACT) | Capture and vent VOC control device with at least 98.5% destruction / recovery device efficiency | SMAQMD |

| BACT DETERMINATION #326 FOR NON-HEATSET LITHOGRAPHIC OFFSET PRINTING | | |
|---|---|---|
| **Pollutant** | **Standard** | **Source** |
| VOC | Compliance with the material limits in SMAQMD Rule 450 Sections 301 and 302. If the total uncontrolled VOC emissions from the unit are ≥ 7,806 lbs per year, a VOC control system must be installed with at least 98.5% overall system efficiency (capture and destruction). | SMAQMD achieved in practice and tech. feasible analysis |
| NOx | No standard | N/A |
| SOx | No standard | N/A |
| PM10 | No standard | N/A |
| PM2.5 | No standard | N/A |
| CO | No standard | N/A |
| Organic HAP/VHAP (T-BACT) | Capture and vent VOC control device with at least 98.5% destruction / recovery device efficiency | SMAQMD |

**APPROVED BY:** *Brian F Krebs* **DATE:** **3/9/2023**

# Attachment A

## Review of BACT Determinations published by EPA

List of BACT determinations published in EPA's RACT/BACT/LAER Clearinghouse (RBLC) for Lithographic Offset Printing Presses:

| Surface Coating/Printing/Graphic Arts (Process 41.000) – Lithographic Offset Printing Presses | | | | | | | |
|---|---|---|---|---|---|---|---|
| **RBLC#** | **Process Number** | **Permit Date(A)** | **Drying** | **Pollutant** | **Standard** | **Control Technology** | **Case-By-Case Basis** |
| IN-0193 | 41.021 | 11/13/2013 | Heatset | VOC | 98% destruction or 10 ppmv; Fountain solution ≤ 3% VOC; Washes ≤ 10 mm Hg at 20°C | Thermal oxidizer; Low VOC materials; good work practices | Other |
| IN-0277 | 41.022 | 3/31/2018 | Heatset | VOC | 98% destruction or 50 ppmv; Fountain solution ≤ 3% VOC; Washes ≤ 10 mm Hg at 20°C or VOC ≤ 2.5 lb/gal | Thermal oxidizer; Low VOC materials; Good work practices | Other |
| IN-0211 | 41.022 | 6/12/2015 | Heatset | VOC | 98% destruction; Fountain solution ≤ 15% VOC; Washes ≤ 10 mm Hg at 20°C or VOC ≤ 7.0 lb/gal | Thermal oxidizer; Low VOC materials | Other |
| IN-0207 | 41.022 | 11/26/2014 | Heatset | VOC | 98% destruction or 50 ppmv; Fountain solution ≤ 3% VOC; Washes ≤ 10 mm Hg at 20°C or VOC ≤ 2.5 lb/gal | Thermal oxidizer; Low VOC materials; Good work practices | Other |
| IN-0164 | 41.023 | 6/28/2013 | Heatset | VOC | 98% destruction or 10 ppmv; Fountain solution ≤ 15% VOC; Washes ≤ 10 mm Hg at 20°C or VOC ≤ 7.0 lb/gal | Thermal oxidizer; Low VOC materials | Other |
| LA-0336 | 41.022 | 11/15/2018 | Non-heatset | VOC | Use of water-based electron beam (EB) or ultraviolet (UV) inks and coatings; Fountain solution ≤ 5% VOC by weight; Washes ≤ 10 mm Hg at 20°C or total VOC ≤ 70% by weight | Low VOC materials; Good work practices | BACT-PSD |

(A) Due to the large number of entries only determinations made (based on Permit Date) entered since 01/01/2012 are included in the above table.

= Selected as the most stringent and most current BACT determinations achieved in practice.

# Attachment B

## Detailed Cost Calculation for Carbon Adsorption

## Data Inputs

| | |
|---|---|
| Select the type of carbon adsorber system: | Fixed-Bed Carbon Adsorber with Steam Regeneration |

**For fixed-bed carbon adsorbers, provide the following information:**

| | |
|---|---|
| Select the type of operation: | Continuous Operation |
| Select the type of material used to fabricate the carbon adsorber vessels: | Stainless Steel, 304 |
| Select the orientation for the adsorber vessels: | Horizontal |

## Enter the design data for the proposed Fixed-Bed Carbon Adsorber with Steam Regeneration

| | | | |
|---|---|---|---|
| Number of operating hours per year ($\Theta_s$) | 2,080 | hours/year | |
| Waste Gas Flow Rate (Q) | 8,000 | acfm (at atmospheric pressure and 77°F) | |
| VOC Emission Rate ($m_{voc}$) | 3.810 | lbs/hour | |
| Required VOC removal efficiency (E) | 98.5 | percent | |
| Superficial Bed Velocity ($v_b$) | 75.00 | ft/min | |
| Estimated equipment life of adsorber vessels and auxiliary Equipment (n) | 15 | Years* | * 15 years is a default equipment life. User should enter actual value, if known. |
| Estimated Carbon life (n) | 5 | Years | |
| Total Number of carbon beds ($N_{total}$) | 3 | Beds* | * 3 beds is the default. User should enter actual number of beds, if known. |
| Number of carbon beds adsorbing VOC when system is operating ($N_A$) | 2 | Beds* | * 2 beds is the default. User should enter actual number of beds, if known. |
| Total time for adsorption ($\Theta_A$) | 12 | hours* | * 12 hours is a default value. User should enter actual value, if known. |
| Total time for desorption ($\Theta_D$) | 5 | hours* | * 5 hours is a default value. User should enter actual value, if known. |
| Estimated Carbon Replacement Rate (CRR) | 379 | lbs/hour* | * 379 lbs./hour is a default value. User should enter actual value, if known. |

## Enter the Characteristics of the VOC/HAP:

| | | |
|---|---|---|
| Name of VOC/HAP | Toluene | |
| Partial Pressure of Toluene in waste gas stream | 0.0104 | psia |
| Parameter "k" for Toluene | 0.551 | **Note:** |
| Parameter "m" for Toluene | 0.110 | Typical values of "k" and "m" for some common VOCs are shown in Table A. |

## Enter the cost data for the carbon adsorber:

| | | | | |
|---|---|---|---|---|
| Desired dollar-year | 2022 | | | |
| CPI for 2022 | 317.299 | CPI value for Oct. 2022 | 168.9 | 1999 |
| Annual Interest Rate (i) | 7 | percent (Current bank prime rate) | | |

| | | | |
|---|---|---|---|
| Electricity ($P_{elec}$) | $0.1124 | per kWh | |
| Steam ($P_s$) | $5.00 | per 1,000 lbs* | * $5.00/1,000 lbs is a default value. User should enter actual value, if known. |
| Cooling Water ($P_{cw}$) | $3.55 | per 1,000 gallons of water* | * $3.55/1,000 gallons is a default value. User should enter actual value, if known. |
| Operator Labor Rate | $27.48 | per hour* | * $27.48/hour is a default value. User should enter actual value, if known. |
| Maintenance Labor Rate | $30.23 | per hour* | * $30.23/hour is a default value. User should enter actual value, if known. If the rate is not kno |
| Carbon Cost (CC) | $4.20 | per lb | * $4.20/lb is a default value based on 2018 market price. User should enter actual value, if kno |
| Re-Sale Value of Recovered VOC ($P_{voc}$) | $0.33 | per lb* | * $0.33/lb is a default value for recovered toluene based on 2018 data. User should enter actu |
| Disposal/Treatment Cost for Recovered VOC ($D_{voc}$) | $0.00 | per lb* | * $0/lb is a default value for disposal and/or treatment of recovered VOC/HAP. User should en |

If known, enter any additional costs for site preparation and building construction/modification:

| | | |
|---|---|---|
| Site Preparation (SP) = | $0 | * Default value. User should enter actual value, if known. |
| Buildings (Bldg) = | $0 | * Default value. User should enter actual value, if known. |
| Equipment Costs for auxiliary equipment (e.g., ductwork, dampers, and stack) ($EC_{aux}$) = | $32,000 | * Default value. User should enter actual value, if known. |
| Contingency Factor (CF) | 10.0 | percent* * 10 percent is a default value. The contingency factor should be between 5 and 15 percent. |

# Cost Estimate

## Capital Costs

**Estimated capital costs for a Fixed-Bed Carbon Adsorber with Steam Regeneration with the following characteristics:**

VOC Controlled/Recovered = Toluene
Adsorber Vessel Orientation = Horizontal
Operating Schedule = Continuous Operation

**Total Capital Investment (TCI) (in 2022 dollars)**

| Parameter | Equation | Cost |
|---|---|---|
| Costs for Each Carbon Adsorber Vessel ($C_v$) = | $271 \times F_m \times S^{0.778}$ = | $27,375 |
| Total Cost for All Carbon Adsorber Vessels and Carbon($EC_{Adsorb}$) = | $5.82 \times Q^{-0.133} \times [C_c + (N_A + N_D) \times C_v]$ = | $147,685 |
| Auxiliary Equipment ($EC_{aux}$) = | (Based on design costs or estimated using methods provided in Section 2) | $32,000 |
| Total Purchased Equipment Costs for Carbon Adsorber (A) = | = $EC_{Adsorb} + EC_{aux}$ = | $179,685 |
| Instrumentation = | 0.10 × A = | Included in A |
| Sales taxes = | 0.03 × A = | $5,391 |
| Freight = | 0.05 × A = | $8,984 |
| | Total Purchased Equipment Costs (B) = | $194,060 |

**Direct Installation Costs (in 2022 dollars)**

| Parameter | Equation | Cost |
|---|---|---|
| Foundations and Supports = | 0.08 × B = | $15,525 |
| Handling and Erection = | 0.14 × B = | $27,168 |
| Electrical = | 0.04 × B = | $7,762 |
| Piping = | 0.02 × B = | $3,881 |
| Insulation = | 0.01 × B = | $1,941 |
| Painting = | 0.01 × B = | $1,941 |
| Site Preparation (SP) = | | $0 |
| Buildings (Bldg) = | | $0 |
| | Total Direct Costs (DC) = B + (0.3 × B) + SP + Bldg = | $252,277 |

**Total Indirect Installation Costs (in 2022 dollars)**

| Parameter | Equation | Cost |
|---|---|---|
| Engineering = | 0.10 × B = | $19,406 |
| Construction and field expenses = | 0.05 × B = | $9,703 |
| Contractor fees = | 0.10 × B = | $19,406 |
| Start-up = | 0.02 × B = | $3,881 |
| Performance test = | 0.01 × B = | $1,941 |
| | Total Indirect Costs (IC) = | $54,337 |
| Contingency Cost (C) = | CF(IC+DC)= | $30,661 |

| | | | |
|---|---|---|---|
| **Total Capital Investment (TCI) =** | **DC + IC + C = (1.28 × B) + SP + Bldg. + C =** | **$337,276** | **in 2022 dollars** |

## Annual Costs

**Direct Annual Costs**

| Parameter | Equation | Cost | |
|---|---|---|---|
| Annual Electricity Cost = | $Q_{Elec} \times P_{elec}$ = | $525 | |
| Annual Steam Cost ($C_s$) = | $3.50 \times m_{voc} \times \Theta_s \times P_s$ = | $139 | |
| Annual Cooling Water Cost ($C_{cs}$) = | $3.43 \times C_s/P_s \times P_{wc}$ = | $338 | |
| Operating Labor Costs: | Operator = 0.5 hours/shift × Labor Rate × (Operating hours/8 hours/shift) | $3,572 | |
| | Supervisor = 15% of Operator | $536 | |
| Maintenance Costs: | Labor = 0.5 hours/shift × Labor Rate × (Operating Hours/8 hours/shift) | $3,930 | |
| | Materials = 100% of maintenance labor | $3,930 | |
| Carbon Replacement Costs: | Labor = $CRF_{carbon} \times$ (Labor Rate × $M_c$)/CRR = | $8 | |
| | Carbon = $CRF_{carbon} \times CC \times M_c \times 1.08$ = | $455 | |

| | | |
|---|---|---|
| **Direct Annual Costs (DAC) =** | **$13,432** | **in 2022 dollars** |

**Indirect Annual Costs**

| Parameter | Equation | Cost |
|---|---|---|
| Overhead | = 60% of sum of operator, supervisor, maintenance labor Plus maintenance materials | $7,181 |
| Administrative Charges | = 2% of TCI | $6,746 |
| Property Taxes | = 1% of TCI | $3,373 |
| Insurance | = 1% of TCI | $3,373 |
| Capital Recovery | = $CRF_{Adsorber} \times$ (TCI - [(1.08 x CC x $M_c$) + (LR x $M_c$/CRR)] = | $36,823 |

| | | |
|---|---|---|
| **Indirect Annual Costs (IAC) =** | **$57,494** | **in 2022 dollars** |

**Recovered Solvent Credit/Disposal Costs**

**Disposal Cost**

| Parameter | Equation | Cost |
|---|---|---|
| VOC Disposal/Treatment Costs (*Disposal $_{cost}$*) | $= m_{voc} \times \Theta_s \times D_{voc} \times E =$ | $0 |

**VOC Recovery Credit**

| Parameter | Equation | Cost |
|---|---|---|
| Annual Recovery Credit for Condensate (RC) | $= m_{voc} \times \Theta_s \times P_{voc} \times E =$ | $2,576 |

| | | | |
|---|---|---|---|
| **Total Annual Cost (TAC) =** | **DAC + IAC + C + Disposal$_{Cost}$ - RC =** | **$68,351** | **in 2022 dollars** |

## Cost Effectiveness

**Cost Effectiveness**

| Parameter | Equation | Cost | |
|---|---|---|---|
| Total Annual Cost = | TAC = | $68,351 | per year in 2022 dollars |
| Annual Quantity of VOC Removed/Recovered = | $W_{voc} = m_{voc} \times \Theta_s \times E =$ | 3.90 | tons/year |
| Cost Effectiveness = | Total Annual Cost (TAC) / Annual Quantity of VOC Removed/Recovered = | $17,512.48 | per ton of pollutants removed/recovered in 2022 dollars |

# Attachment C

## Detailed Cost Calculation for Thermal Oxidizers

## Data Inputs

Select the type of oxidizer: Regenerative Thermal Oxidizer

**Enter the following information for your emission source:**

| Composition of Inlet Gas Stream | | | | |
|---|---|---|---|---|
| Pollutant Name | Concentration (ppmv) | Lower Explosive Limit (LEL) (ppmv)* | Heat of Combustion (Btu/scf) | Molecular Weight |
| Toluene | 59 | 11,000 | 4,274 | 92.13 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Note: The lower explosion limit (LEL), heat of combustion and molecular weight for some commonly used VOC/HAP are provided in the table below.

**Enter the design data for the proposed oxidizer:**

| | | | |
|---|---|---|---|
| Number of operating hours/year | 2,080 | hours/year | |
| Inlet volumetric flow rate($Q_{wi}$) at 77°F and 1 atm. | 20,000 | scfm* | * 20,000 scfm is a default volumetric flow rate. User should enter actual value, if known. |
| Inlet volumetric flow rate($Q_{wi}$) (actual conditions) | 20,900 | acfm* | * 20,900 acfm is a default volumetric flow rate. User should enter actual value, if known. |
| Pressure drop (ΔP) | 19 | inches of water | * 23 inches of water is the default pressure drop for thermal oxidizers; 19 inches of water is the default pressure drop for catalytic oxidizers. Enter actual value, if known. |
| Motor/Fan Efficiency (ε) | 60 | percent* | * 60% is a default fan efficiency. User should enter actual value, if known. |
| Inlet Waste Gas Temperature ($T_{wi}$) | 77 | °F | |
| Operating Temperature ($T_{fi}$) | 1,900 | °F | * Note: Default value for Tfi is 2000°F for thermal regenerative oxidizers. Use actual value if known. Tfi for regenerative oxidizers typically between 1800 and 2000°F. |
| Destruction and Removal Efficiency (DRE) | 98.5 | percent | |
| Estimated Equipment Life | 20 | Years* | * 20 years is the typical equipment life. User should enter actual value, if known. |
| Heat Loss (η) | 1 | percent* | * 1 percent is a default value for the heat loss. User should enter actual value, if known. Heat loss is typically between 0.2 and 1.5%. |

Percent Energy Recovery (HR) = 70 percent

**Enter the cost data:**

| | | | | |
|---|---|---|---|---|
| Desired dollar-year | 2022 | | | |
| CPI for 2022 | 317.299 | Enter the CPI value for Oct. 2022 | 247.705 | 2016 CPI |
| Annual Interest Rate (i) | 7 | Percent | | |
| Electricity ($Cost_{elect}$) | 0.1124 | $/kWh | | |
| Natural Gas Fuel Cost ($Cost_{fuel}$) | 0.0146 | $/scf | | |
| Operator Labor Rate | $27.48 | per hour | | |
| Maintenance Labor rate | $30.23 | per hour | | |
| Contingency Factor (CF) | 10.0 | Percent | | |

* 10 percent is a default value for construction contingencies. User may enter values between 5 and 15 percent.

# Cost Estimate

| Direct Costs | | | |
|---|---|---|---|
| **Total Purchased equipment costs (in 2022 dollars)** | | | |
| Incinerator + auxiliary equipment[a] (A) = | | | |
| Equipment Costs (EC) for Regenerative Oxidizer | =[2.664 x 100,000 + (13.98 x Qtot)] x (2022 CEPI/2016 CEPCI) = | $700,103 | in 2022 dollars |
| Instrumentation[b] = | 0.10 × A = | $70,010 | |
| Sales taxes = | 0.03 × A = | $21,003 | |
| Freight = | 0.05 × A = | $35,005 | |
| | Total Purchased equipment costs (B) = | $826,122 | in 2022 dollars |

Footnotes

a - Auxiliary equipment includes equipment (e.g., duct work) normally not included with unit furnished by incinerator vendor.

b - Includes the instrumentation and controls furnished by the incinerator vendor.

| | | | |
|---|---|---|---|
| **Direct Installation Costs (in 2022 dollars)** | | | |
| Foundations and Supports = | 0.08 × B = | $66,090 | |
| Handlong and Errection = | 0.14 × B = | $115,657 | |
| Electrical = | 0.04 × B = | $33,045 | |
| Piping = | 0.02 × B = | $16,522 | |
| Insulation for Ductwork = | 0.01 × B = | $8,261 | |
| Painting = | 0.01 × B = | $8,261 | |
| Site Preparation (SP) = | | $0 | |
| Buildings (Bldg) = | | $0 | |
| | Total Direct Installaton Costs = | $247,837 | |
| Total Direct Costs (DC) = | Total Purchase Equipment Costs (B) + Total Direct Installation Costs = | $1,073,958 | in 2022 dollars |
| **Total Indirect Installation Costs (in 2022 dollars)** | | | |
| Engineering = | 0.10 × B = | $82,612 | |
| Construction and field expenses = | 0.05 × B = | $41,306 | |
| Contractor fees = | 0.10 × B = | $82,612 | |
| Start-up = | 0.02 × B = | $16,522 | |
| Performance test = | 0.01 × B = | $8,261 | |
| | Total Indirect Costs (IC) = | $231,314 | |
| Continency Cost (C ) = | CF(IC+DC)= | $130,527 | |
| **Total Capital Investment =** | **DC + IC +C =** | **$1,435,800** | **in 2022 dollars** |

| Direct Annual Costs | | |
|---|---|---|
| Annual Electricity Cost | = Fan Power Consumption × Operating Hours/year × Electricity Price = | $18,104 |
| Annual Fuel Costs for Natural Gas | = $Cost_{fuel}$ × Fuel Usage Rate × 60 min/hr × Operating hours/year | $71,403 |
| Operating Labor | Operator = 0.5hours/shift × Labor Rate × (Operating hours/8 hours/shift) | $3,572 |
| | Supervisor = 15% of Operator | $536 |
| Maintenance Costs | Labor = 0.5 hours/shift × Labor Rate × (Operating Hours/8 hours/shift) | $3,930 |
| | Materials = 100% of maintenance labor | $3,930 |
| **Direct Annual Costs (DC) =** | | **$101,474 in 2022 dollars** |

| Indirect Annual Costs | | |
|---|---|---|
| Overhead | = 60% of sum of operating, supervisor, maintenance labor and maintenance materials | $7,181 |
| Administrative Charges | = 2% of TCI | $28,716 |
| Property Taxes | = 1% of TCI | $14,358 |
| Insurance | = 1% of TCI | $14,358 |
| Capital Recovery | = CRF[TCI-1.08(cat. Cost)] | $135,529 |
| **Indirect Annual Costs (IC) =** | | **$200,142 in 2022 dollars** |

| | | |
|---|---|---|
| **Total Annual Cost =** | **DC + IC =** | **$301,617 in 2022 dollars** |

## Cost Effectiveness

Cost Effectiveness = (Total Annual Cost)/(Annual Quantity of VOC/HAP Pollutants Destroyed)

| | | |
|---|---|---|
| Total Annual Cost (TAC) = | $301,617 | per year in 2022 dollars |
| VOC/HAP Pollutants Destroyed = | 17.200 | tons/year |
| Cost Effectiveness = | $17,535 | per ton of pollutants removed in 2022 dollars |